SCIENCE AND TECHNOLOGY BENEFIT ANALYSIS

Idaho Operations Office – Idaho National Engineering and Environmental Laboratory
Bechtel-BWXT, LLC.

LECHLER SPRAYBALL – TANK WALL CLEANING SYSTEM

The walls of the waste tanks at the INEEL Tank Farm Facility must be cleaned in accordance with the RCRA Closure Plans negotiated with the State of Idaho. The INEEL High Level Waste (HLW) Program has deployed an integrated Sprayball System with directional Spray Nozzles in tank WM-182 that can clean the tank walls and homogenize the tank heels, while minimizing generation of secondary waste. This system may subsequently allow deployment of a simplified, more cost-effective sampling technology for collecting representative samples. The INEEL HLW Program established a phased approach for accomplishing deployment of this system that ensures the effectiveness of the technologies in meeting the closure requirements. The first step in this process was deployment of the prototype Lechler Spray Nozzles, the key component of the integrated Spray Nozzle/Sprayball System. This deployment, which was completed in February 2001, successfully demonstrated the ability of the water jets to meet or exceed the closure requirements in effectively removing waste residuals and scale from tank walls. This eliminates the need to develop a pressure nozzle end-effector for the Light Duty Utility Arm, the baseline technology for cleaning the walls. It will also reduce the use of more aggressive chemical cleaning techniques. Due to the success of the initial deployment of the Lechler Spray Nozzles, the HLW Program then transitioned to the next phase in this effort, deployment of the integrated Sprayball System. This system, which was deployed in WM-182 on August 28, 2001, effectively cleans the tank walls and homogenizes the tank heel, allowing a reduced number of heel samples to be taken. Incorporation of directional Lechler Spray Nozzles into this integrated system provides for removal of heel residuals trapped around cooling coils, as well as cleaning stubborn deposits on tank walls and piping.

Qualitative Benefit Analysis

Programmatic Risk	●	The INEEL HLW Program could not complete tank cleaning and closures on schedule and within budget if remotely operated equipment (i.e. LDUA) was required for cleaning each tank.
Technical Adequacy	◒	The Lechler Sprayball, a key component of the integrated Spray Nozzle/Sprayball System, is as effective at cleaning tank walls as the baseline alternative, but also homogenizes the heel.
Safety	◒	Successful application of the Lechler Sprayball reduces the need for chemical cleaning techniques, which are inherently less safe than the use of water.
Schedule Impact	○	Project schedules were not affected.

●	◒	○	◓	◉
Major improvement	Some improvement	No change	Somewhat worse	Major decline

Quantitative Benefit Analysis

Cost Impact Analysis	Cost avoidance was achieved by not having to deploy the LDUA or similar remote equipment to clean tank walls.	
	Annual Savings	$0.48M
	Life Cycle Cost Savings	$5.3M
	Return-On-Investment (ROI)	49%

SCIENCE AND TECHNOLOGY BENEFIT ANALYSIS
DEPLOYMENT APPROVALS

Technology Deployed: LECHLER SPRAYBALL TANK WALL CLEANING SYSTEM

Date Deployed: August 28, 2001

EM Program(s) Impacted: High Level Waste Program

Approval Signatures

J. H. Valentine 8/30/01
Contractor Program Manager Date

N/A
Contractor Program Manager Date

for J T Case 8/30/01
DOE-ID Program Manager Date

N/A
DOE-ID Program Manager Date

Worksheet 1: Operating & Maintenance Annual Recurring Costs

Expense Cost Items *	Before (B) Annual Costs	After (A) Annual Costs
1. Equipment	$ 125.00	$ 125.00
2. Purchased Raw Materials and Supplies	$ -	$ -
3. Process Operation Costs:		
Utility Costs	$ -	$ -
Labor Costs	$ 1,700.00	$ 845.00
Routine Maintenance Costs for Processes	$ 212.00	$ 106.00
Subtotal	$ 1,912.00	$ 951.00
4. PPE and Related Health/Safety/Supply Costs	$ -	$ -
5. Waste Management Costs:		
Waste Container Costs	$ -	$ -
Treatment/Storage/Disposal Costs	$ -	$ -
Inspection/Compliance Costs	$ -	$ -
Subtotal	$ -	$ -
6. Recycling Costs		
Material Collection/Separation/Preparation Costs:		
a) Material and Supply Costs	$ -	$ -
b) Operations and Maintenance Labor Costs	$ -	$ -
Vendor Costs for Recycling	$ -	$ -
Subtotal	$ -	$ -
7. Administrative/other Costs	$ -	$ -
Total Annual Cost:	$ 2,037.00	$ 1,076.00

* See attached Supporting Data and Calculations.

Worksheet 2: Itemized Project Funding Requirements*
(i.e., One Time Implementation Costs)

Category	Cost $
INITIAL CAPITAL INVESTMENT	
1. Design	$ 450
2. Purchase	$ 125
3. Installation	$ 175
4. Other Capital Investment (explain)	$ -
Subtotal: Capital Investment= (C)	$ 750
INSTALLATION OPERATING EXPENSES	
1. Planning/Procedure Development	$ 200
2. Training	$ 145
3. Miscellaneous Supplies	$ -
4. Startup/testing	$ 350
5. Readiness Reviews/Management Assessment/Administrative Costs	$ 200
6. Other Installation Operating Expenses (explain)	$ -
Subtotal: Installation Operating Expense = (E)	$ 895
7. All company adders (G & A/PHMC Fee, MPR, GFS, Overhead, taxes, etc.)(if not contained in above items)	$ -
Total Project Funding Requirements=(C + E)	$ 1,645
Useful Project Life = (L) 11 Years Time to Implement: 1 Months	
Estimated Project Termination/Disassembly Cost (if applicable) = (D) (Only for Projects where L<5 years; D=0 if L>5 years)	$ -

TOTAL LIFE-CYCLE COST SAVINGS CALCULATION FOR IPABS-IS

(Before - After) x (Useful Life) - (Total Project Funding Requirements + Termination)

Total Life Cycle Cost Savings Estimate = (B - A) x L - (C+E+D)

RETURN ON INVESTMENT CALCULATION

Return on Investment (ROI) % =

$$\frac{\textit{(Before - After) - [(Total Project Funding Requirements + Termination)/Useful Life]}}{\textit{[Total Project Funding Requirements + Project Termination]}} \times 100$$

$$\text{ROI} = \frac{\text{(B-A)-[(C+E+D)/L}}{\text{(C+E+D)}} \times 100 \quad 49 \ \%$$

O&M Annual Recurring Costs:				Project Funding Requirements:			
Annual Costs, Before=	$	2,037	(B)	Capital Investment=	$	750	(C)
Annual Costs, After=	$	1,076	(A)	Installation Op. Exp=	$	895	(E)
Net Annual Savings=	$	961	(B-A)	Total Project Funds=	$	1,645	(C+E)

Note: Before (B) and After (A) are Operating & Maintenance Annual Recurring Costs from Worksheet 1.

* See attached Supporting Data and Calculations.

ESTIMATE BASIS FOR: LECHLER SPRAY NOZZLE DEPLOYMENT

GENERAL

Although this Deployment Benefit Statement specifically addresses the Lechler Sprayball technology, it is only one component of an integrated system that includes the Spray Nozzles, Sprayball System, and, potentially, the INEEL Simple Sampler. Consequently, the cost avoidance calculations are based on deployment of the integrated Nozzle/Sprayball system, with additional comments on potential future cost savings that could be realized through deployment of the Simple Sampler for tank closures, where appropriate. The primary source of the cost avoidance is through reduced requirements for the number of samples and associated analyses. Without the Spray Nozzle/Sprayball integrated system, sampling requirements for each tank would be between 10 and 30 samples. Due to deployment of the new approach, only 5 samples will be required. This significantly reduces the analytical costs, as well as the maintenance costs on the LDUA due to reduced exposure to highly acidic, highly radiaoctive tank heels. For purposes of these cost avoidance calculations, only 10 samples are assumed as the baseline. Because the Lechler Spray Nozzles are only one ocmponent of the integrated system, credit is taken for only half of the cost avoidance that will be realized upon deployment of the integrated system, which will be completed by the end of August 2001. Note that this is considered "cost avoidance" since the INEEL HLW Program budget, which is projected flat in the outyears, is not adequate to support the baseline technology.

INITIAL CAPITAL INVESTMENT

The initial capital investments were co-funded by EM-40 INEEL HLW Program and EM-50 Tanks Focus Area. The total amount of $750K reflects equipment purchase, design, and installation of the fully integrated system. The costs of actual equipment for the Spray Nozzles and Sprayball systems is $125K. Although the LDUA end-effector nozzles were never constructed, they are estimated to cost $125K also, based on experience building other end-effectors.

INSTALLATION AND START-UP

Installation and start-up costs of $895K represent the actuals from the Spray Nozzle/Sprayball System deployment.

TRADITIONAL (BASELINE) TECHNOLOGY/METHOD

The baseline for cleaning tank walls and sampling the residual heel material is the Light Duty Utility Arm (LDUA). However, to use this equipment a new end-effector with a spray nozzle would have to be designed, prototyped, tested, and then deployed. Although this system would have been capable of washing the tank walls, heel homogenization is not expected to be as effective as the Spray Nozzle/Sprayball integrated system due to the force limitations inherent in the design of the LDUA. This would have most likely required redesign of the LDUA itself, rather than just end-effector design. Since the baseline technology is use of the existing LDUA with a spray nozzle end-effector, the initial design, testing, and installation costs were estimated to be comparable to those of the Spray Nozzle/Sprayball system.

ESTIMATE BASIS FOR: LECHLER SPRAY NOZZLE DEPLOYMENT

NEW TECHNOLOGY/ METHOD

The Spray Nozzle/Sprayball integrated system is more effective at cleaning the tank walls and moving tank heel residuals to the steam jets for transfer out of the tank. The Sprayball unit is a mechanical system that repeats a spray pattern that covers the entire area of the tank walls and agitates the tank heel such that it becomes homogenized during the wall cleaning cycle. This can then be effectively pumped out of the tank using the steam jet. As the heel/wash water level is pumped down residual heel materials trapped between cooling coils and other stubborn deposits on walls and piping can be washed more directly using the Spray Nozzles, which can be directionally controlled to concentrate in a small area. This results in a cleaner tank, less operational time, and lower volume of secondary waste generation.

COST SAVINGS/COST AVOIDANCE/RISK REDUCTION

The cost savings is primarily due to the reduction of samples required. Because the heel is effectively homogenized, the number of heel samples drops from ten (this is a minimum, the actual number could be up to 30 samples) to five. The analytical costs for each sample is $125K. Accordingly, the analytical costs are reduced from $1.25M to $625K. Additionally, the LDUA preventive (PM) and corrective maintenance (CM) costs are reduced. Operating experience indicates that annual PMs cost $117K, and the CMs average $190K every two years. This correlates to $212K per year for LDUA maintenance. Since the number of times that the LDUA is exposed to the highly acidic, highly radioactive heel materials is reduced by half, the maintenance costs are expected to be reduced accordingly. Cost savings will also be associated with reduced operating time and lower volumes of secondary waste generated. Based on past LDUA deployments, overall operating expenses reduced from $450K per deployment to $220K. The total calculated life-cycle cost avoidance for deployment of the integrated Spray Nozzle/Sprayball System is $10.6M. However, since the initial deployment, which included only the Lechler Spray Nozzle, represented half of the full system, credit was taken for half of the total projected cost avoidance, $5.3M. Likewise, this deployment, the Sprayball system, takes credit for the remaining $5.3M. Other potential future cost savings may result from deployment of the INEEL Simple Sampler for sampling tank heels. The technology is scheduled to be deployed for sampling the sumps in the tank annulus areas, but it may also be applicable for tank heels. The first three tank closures will be accomplished using the LDUA to sample the homogenized heel. If the results of these efforts show that there is no bias in the analysis results for the five samples, an argument can be made that the LDUA is not necessary for off riser sampling. This would allow use of the Simple Sampler, which would result in an additional estimated $800K cost savings per tank.